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NOTES ON THE FRESHWATER SHRIMPS OF ISLA DEL COCO WITH THE DESCRIPTION OF *MACROBRACHIUM COCOENSE,* NEW SPECIES

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Abstract.—Five species of freshwater shrimp are reported from Isla del Coco: *Macrobrachium hancocki, M. americanum, M. cocoense* n. sp., *M.* sp., and *Archaeatya chacei.* Habitat notes are presented for each species, and chela dimorphism in *A. chacei* is noted.

Isla del Coco is an isolated oceanic island located at 5°32′57″ N and 86°59′17″ W about 500 km southwest of Costa Rica. It is a small island about 23.3 km in circumference with abundant fresh water. The highest point is reported to be about 850 m, although at least one report states 518 m as the greatest elevation (see Hertlein 1963). Hertlein (1963) reviewed the biogeography of the island and presented a checklist of the fauna and a bibliography. In the list of 50 decapod crustaceans he included two freshwater species: *Macrobrachium americanum* Bate and *M. hancocki* Holthuis. A third freshwater decapod, *Archaeatya chacei,* was described by Villalobos (1959).

In 1973 one of us (LGA) had the opportunity, provided by the Smithsonian Tropical Research Institute, to visit Isla del Coco and to make some general collections there. In addition to the three previously reported freshwater shrimp species, a single male of an undescribed species of *Macrobrachium* was collected from a stream emptying into Wafer Bay. A male specimen of another *Macrobrachium* was collected from the same stream and is described but not named.

In the descriptions that follow, the abbreviation tl refers to total length including the rostrum, cl to carapace length from the posterior dorsal margin to the posterior orbital margin, and USNM to the National Museum of Natural History, Washington, D.C. Drawings were made with the aid of a Wild M-5 camera lucida by the second author.

Macrobrachium cocoense, new species
Figs. 1–2

Material.—Isla del Coco, Costa Rica, stream on east side of Wafer Bay; 1 ♂; 14 Aug 1973; coll. L. G. Abele, J. Rodgers.

Description of holotype.—Rostrum convex posteriorly, very slightly upturned anteriorly, overreaching antennular peduncle but falling short of distal end of scaphocerite; armed dorsally with 11 teeth, including 2 postorbital; teeth about equally spaced from second to ninth tooth; distinct space between ninth and 2 anteriormost teeth; armed ventrally with 6 teeth, spaced more closely posteriorly; lateral ridge sloping slightly upward anteriorly, merging with orbital margin posteriorly.

Carapace covered with minute spinules (=very short setae) most distinct in anterior and anterolateral region; lower orbital angle rounded; hepatic spine dis-

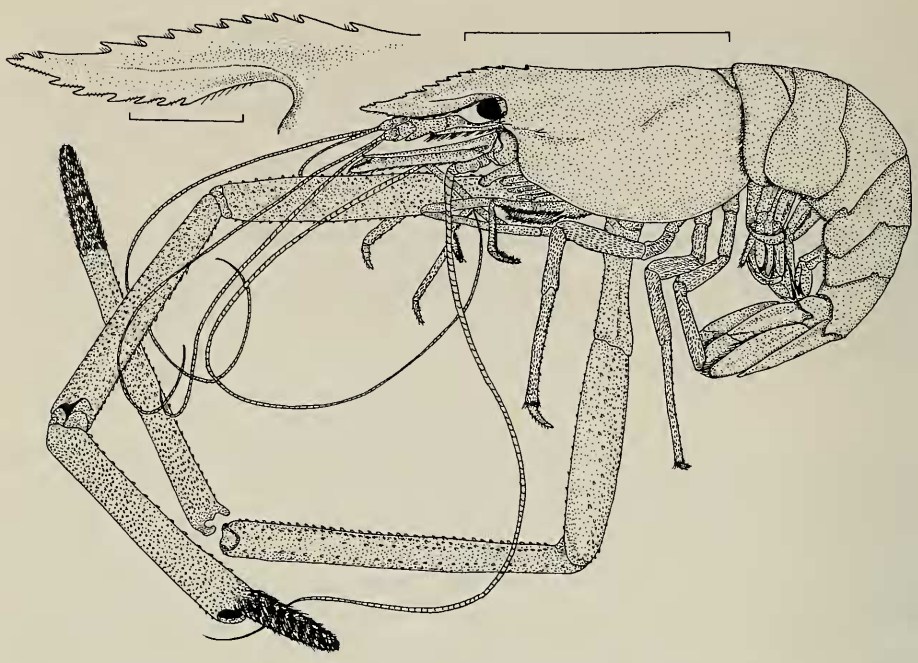

Fig. 1. *Macrobrachium cocoense,* male holotype, lateral view. Scale = 50 mm. Pleuron of third abdominal somite damaged. Rostrum scale = 10 mm.

tinctly smaller than antennal spine; distinct hepatic and branchiocardiac grooves present; region behind orbital margin slightly depressed.

Abdomen covered with very small spinules except dorsal part of first 3 somites; pleura covered with very short setae similar to those on carapace; pleura of first 3 somites broadly rounded posteroventrally; pleuron of fourth somite angular; pleuron of fifth somite somewhat triangular; sixth somite with acute ventral and subdorsal posterior margins, about 1.4 times as long as fifth. Telson covered with minute spinules, about 1.5 times as long as sixth somite, with one pair of dorsal spines at midlength and only one (right) spine at ⅔ length of telson; posterior margin distinct, ending in median acute point; apex falling far short of tips of inner of 2 pairs of posterior spines; several feathered setae present between inner spines.

Cornea rounded and broader than eyestalk; ocellus distinct.

Antennule with stylocerite extending beyond midlength of penultimate segment of antennule; ultimate segment slightly longer than penultimate segment in dorsal view; antepenultimate segment lengthened laterally and ventrally.

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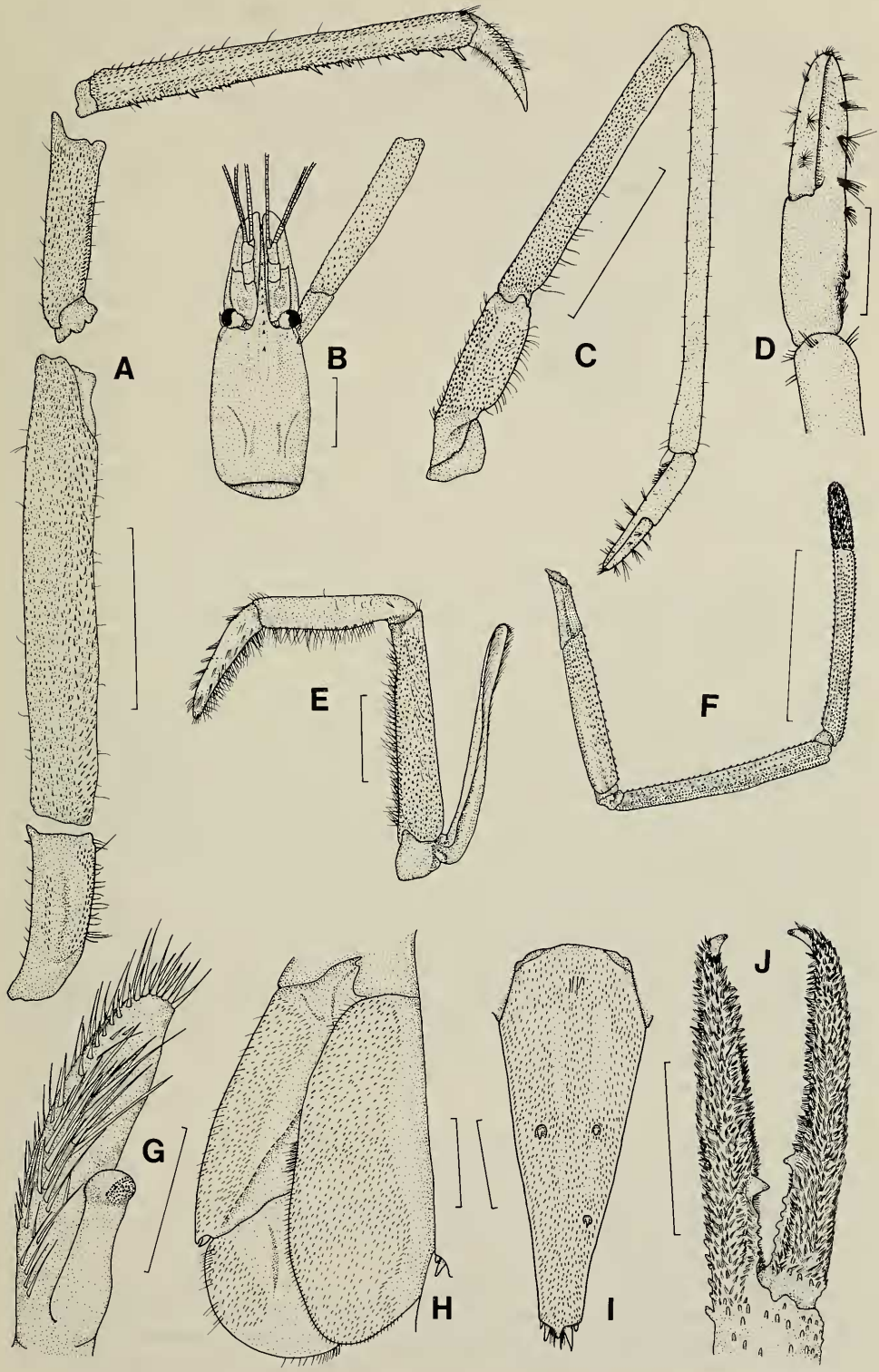
Fig. 2. *Macrobrachium cocoense,* male holotype: A, Right third pereopod; B, Dorsal view of anterior region; C, Right first pereopod; D, Chela of right first pereopod; E, Left third maxilliped; F, Left second pereopod; G, Right appendix masculina; H, Left uropod; I, Telson; J, Fingers of left second pereopod. Scale: A, C, J = 10 mm, B = 20 mm, D = 3 mm, E, H, I = 5 mm, F = 50 mm, G = 2 mm.


A
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J

Scaphocerite overreaching rostrum, almost 3 times as long as broad; outer margin almost straight, ending in short spine falling far short of distal margin of inner blade.

Third maxilliped falling slightly short of middle of scaphocerite; antepenultimate segment with many very small spinules laterally, about 1.4 times as long as penultimate; penultimate about 1.3 times as long as ultimate; penultimate and antepenultimate segments with many long setae; exopod extending to distal margin of antepenultimate segment.

First pereopods reaching with chela and part of carpus beyond scaphocerite; fingers slightly longer than palm; carpus 2.9 times as long as chela and 1.4 times as long as merus; merus and ischium with dense spinules ventrally, increasing in size proximally. Second pereopods similar in shape, unequal in size, overreaching scaphocerite by carpus and $\frac{3}{5}$ length of merus. Left pereopod with fingers 0.36 times as long as palm, closing over their entire length; movable finger with large basal tooth about $\frac{7}{10}$ of length from tip, 5 small denticles present between base of edge and large tooth, edge entire distal to large tooth; immovable finger with large tooth somewhat proximal to large one of movable finger, armed with 5 denticles between base and large tooth; both fingers covered with thick pubescence; palm elongate and cylindrical, about 11 times as long as high, with several longitudinal rows of spinules becoming larger lateroventrally; carpus longer than palm, though being shorter than entire chela, about 9.5 times as long as broad, narrowing slightly proximally; merus slightly swollen, broadest in middle, about 0.7 times as long as carpus, about 2 times as long as compressed ischium; carpus, merus, and ischium with several longitudinal rows of spinules being larger midventrally. Third through fifth pereopods similar, covered with very short, dense spinules on all segments except dactylus. Third pereopod reaching with part of dactylus beyond scaphocerite; propodus 3.7 times as long as dactylus, 1.7 times as long as carpus and 0.8 times as long as merus. Fifth pereopod reaching somewhat beyond middle of scaphocerite; propodus almost 4.5 times as long as dactylus, 1.9 times as long as carpus and equal in length to merus; inferior margin of propodus with strong spines and rows of transverse, long setae.

First pleopods lacking appendix interna; endopod less than half as long as exopod. Appendix masculina present on second pleopod, about 2 times as long as appendix interna, with strong, stiff setae on superior surface and tip.

Uropods ovate, extending well beyond telson; lateral ramus slightly longer than mesial; diaeresis with one movable spine mesial to immovable spine at lateral angle; minute spinules on surface of uropods.

Holotype.—The male holotype (tl = 166.5 mm, cl 39.6 mm) is deposited in the USNM.

Habitat.—*Macrobrachium cocoense* was collected with a dip net in a slow-flowing, almost stagnant, freshwater stream. The depth was about 1 m, width 3–4 m and the bottom was mud and rotting vegetation. Visibility was virtually zero.

Color.—Carapace and abdomen predominately light brown mottled with black; abdomen bronze posteriorly; chelipeds black.

Remarks.—*Macrobrachium cocoense* is morphologically similar to two other eastern Pacific species in the genus, *M. tenellum* (Smith) and *M. rathbunae* Holthuis. We have examined specimens of both of these species, including the type-specimen of *M. rathbunae*. *Macrobrachium cocoense* can be easily distinguished

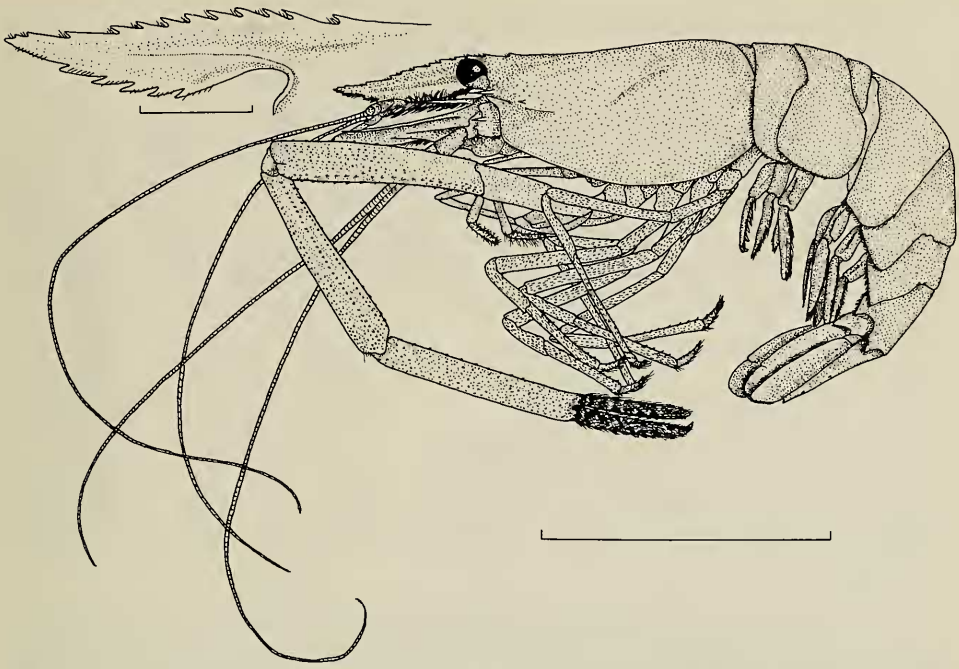

Fig. 3. *Macrobrachium* sp., lateral view. Scale = 50 mm. Abdomen disarticulated at third somite. Rostrum scale = 10 mm.

from *M. tenellum* by the following characters: in *M. cocoense* the fingers of the second pereopod are about 0.36 as long as the palm, while in *M. tenellum* they are about 0.8 as long; in *M. cocoense* the rostrum is almost straight, while in *M. tenellum* it is distinctly curved upward.

The present species can be distinguished from *M. rathbunae* by the following characters: in *M. cocoense* the carpus of the first pereopod is about 2.9 times the chela length, while in *M. rathbunae* it is about 2.0 times the chela length; in *M. cocoense* the second pereopods extend beyond the scaphocerite by the carpus and about 0.6 of the merus while in *M. rathbunae* they extend beyond the scaphocerite by the carpus only; in *M. cocoense* the fingers of the second pereopod are about 0.36 as long as the palm, while in *M. rathbunae* they are about 0.5–0.6 as long; in *M. cocoense* there are dense, strong spinules on pereopods 2–5, while in *M. rathbunae* they are fewer and weaker.

Etymology.—From the type-locality.

Macrobrachium sp.
Figs. 3–4

Material.—Isla del Coco, Costa Rica, stream on east side of Wafer Bay; 14 Aug 1973; coll. L. G. Abele.

Description.—Rostrum armed with 12 teeth dorsally, including one postorbital and one above orbital margin; armed ventrally with 5 teeth. Carapace smooth.

Abdomen smooth; pleura covered with indistinct short setae, sparse ventrally.

Telson sparsely covered with very small spinules.

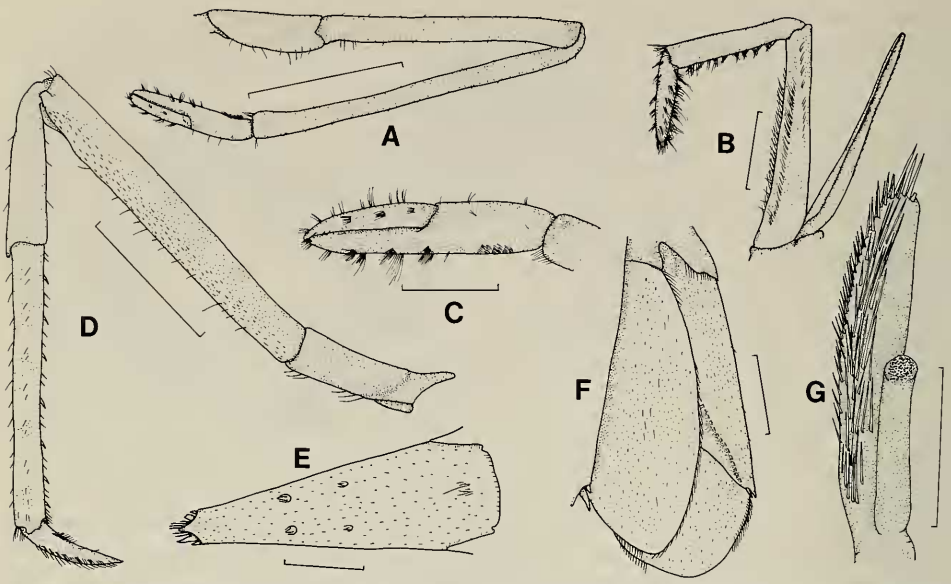

Fig. 4. *Macrobrachium* sp.: A, Right first pereopod; B, Left third maxilliped; C, Chela of left first pereopod; D, Left third pereopod; E, Telson; F, Right uropod; G, Left appendix masculina. Scale: A, D = 10 mm, C = 3 mm, B, E, F, G = 5 mm.

Right stylocerite damaged, with 2 lateral spines.

Third maxilliped having segments with long setae ventrally becoming dense proximally.

First pereopods overreaching scaphocerite by length of chela and having segments almost naked, ischium with sparse long setae ventrally. Left second pereopod overreaching scaphocerite by length of carpus and ⅕ length of merus; fingers about 0.6 times as long as palm, covered with pubescence; palm elongate, cylindrical, about 7 times as long as high, with several longitudinal rows of spinules larger and more distinct lateroventrally; carpus about 6.8 times as long as broad; merus 1.6 times as long as ischium; carpus, merus, and ischium with several longitudinal rows of spinules becoming larger lateroventrally. Right second pereopod regenerating. Third through fifth pereopods similar, covered with very short, sparse spinules on narrow area of ventral surface of merus, carpus and propodus. Third pereopod with propodus about 2.5 times as long as dactylus. Fifth pereopod with propodus 3.4 times as long as dactylus.

Uropods with sparse spinules on dorsal surface.

Remarks. The present specimen was collected in the same stream as *M. cocoense* and is virtually identical in size (tl 166 mm, cl 39.6 mm). We considered the possibility that this specimen is conspecific with *M. cocoense,* but without more material we hesitate to make a decision. We also compared it to type-material of *M. rathbunae,* but there are numerous differences in the form of the second pereopod and in the shape of the rostrum. The specimen is also damaged, with an aberrant right stylocerite and a regenerating right second pereopod. It seems best to describe the specimen, without naming it, until more material becomes available.

Table 1.—Comparison of size, sex, and chela type in *A. chacei* from Isla del Coco Island.

Gender		Chela type	CL (mm) 1.1–1.5	1.6–2.0	2.1–2.5	2.6–3.0	3.1–3.5	3.6–4.0	4.1–4.5	4.6–5.0	Total	
Male		Ortmannioid			15	39	22	2			78	
		Atyoid			3	3	1				7	
												85
Female	Non-ovigerous	Ortmannioid	1	7	4	9	7	4	3		35	
		Atyoid		10	31	11	3	5	1		61	
												96
	Ovigerous	Ortmannioid					3	6	6	2	17	
		Atyoid						6	4		10	
												27
Total individuals			1	17	53	62	36	23	14	2		208
% Female			100	100	66	32	36	91	100	100		

Macrobrachium hancocki Holthuis, 1950

Macrobrachium hancocki.—Holthuis, 1952:111, pl. 29, figs. a–e.

Material examined.—Isla del Coco, Wafer Bay, west side in swamp; 8 ♂♂, 13 ♀♀ (8 ovigerous); 15 Aug 1973; coll. L. G. Abele (LGA 73–63).—Wafer Bay, east side in stream; 4 ♂♂, 13 ♀♀ (5 ovigerous); 14 Aug 1973; coll. L. G. Abele (LGA 73-61).

Measurements.—Males cl 7.5–16.9 mm, females cl 7.1–13.8 mm, ovigerous females cl 7.2–11.5 mm.

Type-locality.—Esparta, Rio Barranca, Costa Rica.

Distribution.—This species has been reported from the Pacific drainage of Costa Rica, Panama, and Colombia as well as from Isla del Coco and the Galapagos Archipelago.

Remarks.—*Macrobrachium hancocki* is common on Isla del Coco. A few individuals were observed in a small stream emptying into Chatham Bay. Specimens were seen along the edges of the stream in slow-moving or still areas. This species was extremely common in a swamp on the eastern shore of Wafer Bay. The water was brown, almost stagnant with rotting vegetation on the bottom. Large males, but not small males or females, were a beautiful deep blue in color (see also Holthius 1952:112). Additional collecting around Wafer Bay revealed that *M. hancocki* is most abundant in swamp waters 8–15 cm deep that are slow moving or stagnant.

Abele and Blum (1977) present data on the biology of this species from the Archipielago de las Perlas, Panama.

Macrobrachium americanum Bate, 1868

Macrobrachium americanum.—Holthuis, 1952:128, pl. 31, figs. d, e.

Material examined.—Isla del Coco, Wafer Bay, east side in stream; 1 ♀; 14 Aug 1973; coll. L. G. Abele (LGA 73-61).

Measurements.—Female cl 28.0 mm.

Type-locality.—Lake Amatitlan, Guatemala.

Distribution.—*Macrobrachium americanum* is widely distributed in Pacific drainages from Lower California to northern Peru, including Isla del Coco and the Galapagos Archipelago.

Remarks.—The single female was collected from the larger of two streams on the eastern side of Wafer Bay. Holthuis (1952) reported specimens from a stream entering Chatham Bay. Abele and Blum (1977) reported *M. americanum* from large pools in streams in the Archipielago de las Perlas, Panama.

Archaeatya chacei Villalobos, 1959

Archaeatya chacei Villalobos, 1959:331, figs. 1–25.

Material examined.—Isla del Coco, Chatham Bay, freshwater stream; 57 ♂♂, 97 ♀♀ (25 ovigerous); 13 Aug 1973; coll. L. G. Abele (LGA 73-59).—Wafer Bay, west side, swamp; 28 ♂♂, 20 ♀♀ (2 ovigerous); 14 Aug 1973 (LGA 73-63).—Wafer Bay, east side; 6 ♀♀; 14 Aug 1973 (LGA 73-61).

Measurements.—Males cl 2.1–3.1 mm, females cl 1.2–4.5 mm, ovigerous females cl 3.4–5.0 mm. Panamanian specimens: males cl 2.6–4.6 mm, females cl 2.4–5.6 mm, ovigerous females cl 4.2–5.4 mm.

Type-locality.—Isla del Coco.

Distribution.—Isla del Coco (Villalobos 1959); Costa Rican mainland (Smalley 1964); Archipielago de las Perlas, Panama (Abele and Blum 1977).

Remarks.—Individuals of *A. chacei* were collected from all freshwater streams sampled in Chatham and Wafer Bay watersheds from the sea-stream interface to the greatest altitude sampled (250 m). The species was found in virtually all microhabitats: side pools of streams, moving about on rocks, in fast-flowing riffle areas and among submerged parts of riparian vegetation at or near the shore. Individuals were relatively uncommon in a small stream flowing into Chatham Bay but were abundant in a larger stream flowing southwest in the same area. In the Wafer Bay area local variation in abundance was even more pronounced. A swamp on the east side had almost zero visibility, rotting debris, and flowing water. *Macrobrachium hancocki* was very abundant there, and *A. chacei* rare. On the west there was a swamp with clear, still water, where *A. chacei* was quite abundant and *M. hancocki* rare.

Chela heteromorphism has been described for some members of the Atyidae by Bouvier (1925), Edmondson (1929) and, most recently, by Chace (1983). Chela morphology basically has two forms: the ortmannioid form, in which a palm is present because the dactylus is shorter than the propodus, and the atyoid form, which lacks a palm because the dactylus and propodus are subequal in length. Generally the ortmannioid form has short setae on the chelae and the atyoid form long setae. The two forms can be quite distinct although the chelae of some individuals are difficult to classify.

We examined this phenomenon in *A. chacei* and its relationship to size and sex (Table 1). There are 208 complete specimens, 41% male and 59% female. Among the males 92% are ortmannioid and 8% atyoid, while among the females 42% are ortmannioid and 58% are atyoid. Among the 27 ovigerous females, which include the largest specimens, 63% are ortmannioid and 47% atyoid in form.

Table 2.—Comparison of size, sex, and chela type in *A. chacei* from Archipielago de las Perlas, Panama.

Gender		Chela type	CL (mm) 2.1–2.5	2.6–3.0	3.1–3.5	3.6–4.0	4.1–4.5	4.6–5.0	5.1–5.5	5.6–6.0	Total	
Male		Ortmannioid		12	91	128	74	1			306	
		Atyoid		1		1					2	
												308
Female	Non-ovigerous	Ortmannioid	1	11	29	20	15	13	11	2	102	
		Atyoid	0	1	5		1	1	1		9	
												111
	Ovigerous	Ortmannioid						2	4		6	
		Atyoid					1				1	
												7
Total individuals			1	25	125	149	91	17	16	2		426
% Female			100	48	27	13	19	94	100	100		

The smallest animals appear to be females and no individuals with a cl less than 2.1 mm can be identified as males. Males account for 34–68% of the individuals from cl 2.1–3.5 mm. At cl 3.6–4.0 mm males are rare, accounting for 9% of the individuals. The 16 largest individuals cl 4.1–5.0 mm, are females. Although similar data have been used to suggest protandric hermaphroditism we hesitate to speculate without seasonal and histological data.

We compared the Isla del Coco specimens to individuals collected at Archipielago de las Perlas, Panama, and found no consistent differences except that the Panamanian specimens are larger as noted by Abele and Blum (1977). The sex ratio data may not be valid because these collections were used to measure egg numbers and stomach contents of females, and consequently females were removed from the vials. However, the data are valid to examine size, sex and chela type and to compare these data to those from Isla del Coco. There are 308 complete males, and of these 306 or 99% have ortmannioid chelae. Among the 118 females 108 or 92% have ortmannioid chelae, and 8% have atyoid chelae. The differences between the chela types are not as clear cut in the Panama material as in that from Isla del Coco. The size and sex data differ little from those of Isla del Coco. Other than the absence of animals with cl below 2.0 mm the general trend is the same. Males account for the majority of individuals in the middle size classes but are rare or absent in the larger size classes.

Nothing is known concerning the significance of the chela dimorphism.

Acknowledgments

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